RECYCLABLE VEHICLE INTERIOR ARTICLES AND METHODS OF MAKING SAME

FIELD OF THE INVENTION

The present invention relates generally to vehicles and, more particularly, to vehicle interior trim articles.

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 60/337,666, filed November 7, 2001, the disclosure of which is incorporated herein by reference in its entirety as if set forth fully herein.

BACKGROUND OF THE INVENTION

It is generally desirable for vehicle interior articles, such as floor coverings, instrument panel skins, door panel skins, consoles, and pillars, etc., to have an attractive appearance, to maintain their shape and resist wear over long periods of use, and to provide sound absorption within a vehicle interior. In addition, due to increasing federal environmental regulations and decreasing availability of landfill space, there is increased interest in recycling post-consumer products such as vehicle interior trim panels. Unfortunately, many conventional vehicle interior articles are formed from non-recyclable materials such as thermosetting resins, which cannot be re-melted and reused.

Thus, there is a need for recyclable vehicle interior articles that have durable, tough surfaces, that are impervious to water and most chemicals, and that are

designed to be scratch and mar resistant. In addition, there is a need for recyclable vehicle interior articles that can reduce external noises (*e.g.*, road noise, engine noise, vibrations, etc.), as well as noises emanating from within passenger compartments, while also being lightweight and low in cost.

SUMMARY OF THE INVENTION

In view of the above discussion, recyclable vehicle interior articles for use in a variety of interior trim applications (*e.g.*, floor coverings, instrument panel skins, door panel skins, consoles, and pillars, etc.), and methods of producing same, are provided. According to embodiments of the present invention, vehicle interior articles include a top layer of recyclable polymeric material and a backing layer bonded to the top layer in face-to-face relationship. The top layer includes a blend of various recyclable polymeric materials and has a thickness of between about 1.6 mm and about 2.0 mm. According to an embodiment of the present invention, the top layer includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a limestone component, and barium sulfate component. Various additional components including distilled petroleum products, zinc stearate, pigments, and regrind/recycle materials may also be used.

According to other embodiments of the present invention, vehicle interior articles include a top layer of recyclable polymeric material and a backing layer attached to the top layer in face-to-face relationship. The top layer includes first and second layers of recyclable polymeric material adhered together in face-to-face relationship. The first layer includes a first

interpolymer component having a composition of about twenty to forty percent (20% - 40%) ethylene and about sixty to eighty percent (60% - 80%) aromatic vinyl monomer, a second interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a polyethylene polymer component, and a silicone component. The second layer includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene copolymer component, a polypropylene component, and a limestone component.

The first layer has a thickness of between about 0.75 mm and about 1.0 mm. The second layer has a thickness of between about 1.0 mm and about 1.25 mm. Accordingly, the top layer has a thickness of between about 1.75 mm and about 2.25 mm.

Vehicle interior articles according to embodiments of the present invention may be used in a wide variety of vehicle applications including, but not limited to floor coverings, instrument panel skins, door panel skins, consoles, and pillars, etc. Vehicle trim panels embodying aspects of the present invention are thinner in cross section and, thus, are lighter in weight than conventional vehicle trim panels. In addition, trim panels according to embodiments of the present invention can achieve various performance characteristics including wear resistance, sound absorption, colorability, etc., that are superior to conventional vehicle trim panels. Moreover, vehicle trim panels according to embodiments of the present invention are environmentally friendly in that they can be recycled.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which form a part of the specification, illustrate key embodiments of the present invention. The drawings and description together serve to fully explain the invention.

Fig. 1A is a partial cross-sectional view of a vehicle interior trim panel, according to embodiments of the present invention, that includes a top layer of recyclable polymeric material and a backing layer bonded to the top layer in face-to-face relationship.

Fig. 1B is a partial cross-sectional view of the vehicle interior trim panel of Fig. 1A, wherein the top layer comprises first and second layers of recyclable polymeric material, according to embodiments of the present invention.

Fig. 2A is a partial cross-sectional view of a vehicle interior trim panel, according to embodiments of the present invention, that includes a top layer of recyclable polymeric material that comprises first and second layers of recyclable polymeric material, a middle layer of recyclable polymeric material, and a backing layer that are bonded together in face-to-face relationship.

Fig. 2B is a partial cross-sectional view of the vehicle interior trim panel of **Fig. 2A**, wherein the top layer comprises first and second layers of recyclable polymeric material, according to embodiments of the present invention.

Figs. 3-6 are schematic diagrams that illustrate methods of producing vehicle interior trim panels according to embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention now is described more fully hereinafter with reference to the accompanying

drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

In the drawings, the thickness of lines, layers and regions may be exaggerated for clarity. It will be understood that when an element such as a layer, region, substrate, or panel is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present. It will be understood that when an element is referred to as being "connected" or "attached" to another element, it can be directly connected or attached to the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly connected" or "directly attached" to another element, there are no intervening elements present.

Embodiments of the present invention provide sound attenuating composite articles for use in various applications, particularly automotive applications. Exemplary automotive applications within which sound attenuating composite articles according to embodiments of the present invention may be utilized include, but are not limited to, carpeting for floors, door panels, and other interior portions, and upholstery for various interior portions, such as headliners, dashboards, etc.

As is understood by those skilled in this art, the attenuation of external noise is conventionally referred to as sound transmission loss (STL). The attenuation of internal noise is conventionally referred

to as sound absorption. The acoustic impedance of a material is defined as material density times acoustic velocity, and is expressed in units of Rayls (Newton-seconds/meter^3). Acoustic impedance defines how easy it is for air to move through a material. Thus, for fibrous materials, acoustic impedance depends upon the density of the fibrous material and fiber diameter. Generally, the heavier the blanket and the finer the fibers, the higher the acoustic impedance. Moreover, thicker layers typically have more acoustic impedance than thin layers. The ability of a material to attenuate noise is conventionally defined by the material's STL, acoustic impedance, and absorption characteristics.

For the purposes of the present invention, the term "aromatic vinyl monomer" is to be broadly interpreted and includes, for example, aryl and heterocyclic monomers. Exemplary aromatic vinyl monomers which may be employed include, for example, styrene and styrene derivatives such as alpha-methyl styrene, p-methyl styrene, vinyl toluene, ethylstyrene, tert-butyl styrene, monochlorostyrene, dichlorostyrene, vinyl benzyl chloride, vinyl pyridine, fluorostyrene, alkoxystyrenes (e.g., paramethoxystyrene), and the like, along with blends and mixtures thereof. In addition to the composition range stated herein, the aromatic vinyl monomer may be used in an amount, based on total weight of the monomers, preferably from about five to fifty percent (5% - 50%) by weight, and most preferably from about ten to forty percent (10% - 40%) by weight. A particularly preferred aromatic vinyl monomer is styrene.

Referring initially to **Fig. 1A**, a vehicle interior article **10**, according to embodiments of the present invention, includes a top layer **12** of recyclable polymeric material and a backing layer **14** bonded to the top layer 12 in face-to-face relationship. The top layer

12 and backing layer 14 may be bonded or attached together in various ways, such as via adhesives, heat, extrusion, molding, etc. The interior article 10 may be used in various vehicle interior applications including, but not limited to floor coverings, instrument panel skins, door panel skins, consoles, and pillars, etc.

The top layer 12 includes a blend of various recyclable polymeric materials and has a thickness of between about 1.6 mm and about 2.0 mm. According to an embodiment of the present invention, the top layer includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a filler component (*e.g.*, limestone and/or barium sulfate). Various additional components including distilled petroleum products, dispersing agents (*e.g.*, zinc stearate), pigments, and regrind/recycle materials may also be used. Preferable material compositions and quantities for the top layer 12 that can be utilized in accordance with embodiments of the present invention are set forth in **Table 1** below.

Table 1

Component	Commercial Name/Manufacturer	% By Weight
Interpolymer: 70% ethylene and 30% styrene	DE 200.01/Dow Chemical	38-42%
Polypropylene/ethylene copolymer	Inspire 112/Dow Chemical	4-6%
Polypropylene	H700-12 NPH/ Dow Chemical	13-17%
Limestone ($CaCO_3$)		25-30%
Barium sulfate ($BaSO_4$)		5-10%
Distilled petroleum	Shellflex 6702	3-5%
Zinc stearate		0.2-0.6%

Pigment	Clariant	0.5-1%
Regrind/recycle		0-35%

However, different material quantities may be utilized. Embodiments of the present invention are not limited to only the listed ranges of material quantities.

An interpolymer used in accordance with embodiments of the present invention has good filler absorption characteristics. A polypropylene copolymer used in accordance with embodiments of the present invention enhances low temperature performance and allows the top layer **12** to pass various low temperature flexibility requirements. Moreover, the polypropylene/ethylene copolymer can also improve shrinkage characteristics of the top layer **12** which enhances the ability to be easily thermoformable. A polypropylene according to embodiments of the present invention has a melt index of 12 and works in conjunction with the other polypropylene components to achieve desired hardness and elasticity of the top layer **12**. Limestone is used as a low cost filler and barium sulfate is used to increase specific gravity, which enhances sound attenuation characteristics of the top layer **12**. Barium sulfate also increases resistance to tear, elongation, scuff, and abrasion. Other fillers known to those skilled in the art may be used.

A distilled petroleum product, such as Shellflex 6702, acts as a lubricant in machinery processing the top layer composition and facilitates compounding. Zinc stearate is used to improve filler dispersion and can also increase surface resistance to scuffing. Various polypropylene-based pigments are utilized to produce desired colors. Regrind/recycle material can be used, but is kept separate by color to prevent contamination. The backing layer **14** is a normal

filled material.

Referring to **Fig. 1B**, a vehicle interior article **10'**, according to embodiments of the present invention, includes a top layer of recyclable polymeric material and a backing layer **14** attached to the top layer **12'** in face-to-face relationship. The top layer **12'** includes first and second layers **16**, **18** of recyclable polymeric material adhered together in face-to-face relationship. The interior article **10'** may be used in various vehicle interior applications including, but not limited to floor coverings, instrument panel skins, door panel skins, consoles, and pillars, etc.

The first layer **16**, includes a first interpolymer component having a composition of about twenty to forty percent (20% - 40%) ethylene and about sixty to eighty percent (60% - 80%) aromatic vinyl monomer, a second interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a polyethylene component, and a silicone component. The first layer **16**, has a thickness of between about 0.75 mm and about 1.0 mm.

Exemplary material compositions and quantities for the first layer **16** that can be utilized in accordance with embodiments of the present invention are set forth in **Table 2** below.

Table 2

Component	Commercial Name/Manufacturer	% By Weight
Interpolymer: 70% ethylene and 30% styrene	DE 200.01/Dow Chemical	25-30%
Interpolymer: 30% ethylene and 70% styrene	DE 201.01/Dow Chemical	25-30%

Polypropylene/ethylene copolymer	Inspire 112/Dow Chemical	5-10%
Polypropylene	H700-12 NPH/ Dow Chemical	20-25%
Polyethylene	Dowlex 2045/Dow Chemical	5-10%
Silicone	DMB 1200.1/Dow-Corning	3-5%
Pigment	Clariant	3-5%

The second layer **18**, includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene copolymer component, a polypropylene component, and a limestone component. The second layer **18** has a thickness of between about 1.0 mm and about 1.25 mm. Accordingly, the top layer **12'** has a thickness of between about 1.75 mm and about 2.25 mm.

Exemplary material compositions and quantities for the second layer **18** that can be utilized in accordance with embodiments of the present invention are set forth in **Table 3** below.

Table 3

Component	Commercial Name/Manufacturer	% By Weight
Interpolymer: 70% ethylene and 30% styrene	DE 200.01/Dow Chemical	25-30%
Polypropylene/ethylene copolymer	Inspire 112/Dow Chemical	2-4%
Polypropylene	H700-12 NPH/ Dow Chemical	5-10%
Limestone ($CaCO_3$)		55-60%
Distilled petroleum	Shellflex 6702	4-6%
Zinc stearate		0.2-0.6%
Pigment	Clariant	0.5-1%

Regrind/recycle		0-35%

However, different material quantities may be utilized for the first and second layers **16**, **18**. Embodiments of the present invention are not limited to only the listed ranges of material quantities.

Using a two layer construction for the top layer **12'** can provide increased cost benefits in materials as well as improving abrasion and scuff performance versus the single top layer construction of **Fig. 1A**. The material in the first and second layers **16**, **18** is fully recyclable and can be colored at a lower cost since the first layer **16** is thin and contains no fillers. The use of a first layer **16** also allows for the omission barium sulfate from the formula.

According to other embodiments of the present invention, the backing layer **14** in **Figs. 1A-1B** may be an open cell material, such as would be known to those skilled in the art. According to other embodiments, the backing layer **14** in **Figs. 1A-1B** may be a polypropylene foam sheet.

Referring now to **Fig. 2A**, a vehicle interior article **110**, according to embodiments of the present invention, includes a top layer **12** of recyclable polymeric material, a middle layer **20** of recyclable polymeric material bonded to the top layer **12** in face-to-face relationship, and a bottom layer **22** of recyclable polymeric material bonded to the middle layer **14** in face-to-face relationship. The top, middle, and bottom layers **12**, **20**, **22** may be bonded together in various ways, such as via adhesives, heat, extrusion, molding, etc.

The top layer **12** includes a blend of various recyclable polymeric materials and has a thickness of between about 1.6 mm and about 2.0 mm. According to an

embodiment of the present invention, the top layer includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a limestone component, and barium sulfate component. Various additional components including distilled petroleum products, zinc stearate, pigments, and regrind/recycle materials may also be used. Exemplary material compositions and quantities for the top layer **12** that can be utilized in accordance with embodiments of the present invention are set forth in **Table 1** above. The middle layer **20** may be a polypropylene foam sheet or an open cell material such as would be known to those skilled in the art. The bottom layer **22** may be a polypropylene filled reinforced substrate.

Referring to **Fig. 2B**, a vehicle interior article **110'**, according to embodiments of the present invention, includes a top layer **12'** of recyclable polymeric material, a middle layer **20** of recyclable polymeric material bonded to the top layer **12** in face-to-face relationship, and a bottom layer **22** of recyclable polymeric material bonded to the middle layer **14** in face-to-face relationship. The top, middle, and bottom layers **12'**, **20**, **22** may be bonded together in various ways, such as via adhesives, heat, extrusion, molding, etc.

The top layer **12'** includes first and second layers **16**, **18** of recyclable polymeric material adhered together in face-to-face relationship. The first layer **16** includes a first interpolymer component having a composition of about twenty to forty percent (20% - 40%) ethylene and about sixty to eighty percent (60% - 80%) aromatic vinyl monomer, a second interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent

(20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a polyethylene polymer component, and a silicone component. The first layer **16**, has a thickness of between about 0.75 mm and about 1.0 mm. Exemplary material compositions and quantities for the first layer **16** that can be utilized in accordance with embodiments of the present invention are set forth in **Table 2** above.

The second layer **18**, includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, and a limestone component. The second layer **18** has a thickness of between about 1.0 mm and about 1.25 mm. Accordingly, the top layer **12'** has a thickness of between about 1.75 mm and about 2.25 mm. Exemplary material compositions and quantities for the second layer **18** that can be utilized in accordance with embodiments of the present invention are set forth in **Table 3** above. The middle layer **20** may be a polypropylene foam sheet or an open cell material such as would be known to those skilled in the art. The bottom layer **22** may be a polypropylene filled reinforced substrate.

Referring now to **Fig. 3**, a schematic diagram is provided that illustrates methods of producing a vehicle interior trim panel according to embodiments of the present invention. Initially, a top layer of recyclable polymeric material having a thickness of between about 1.6 mm and about 2.0 mm and having the following components is provided: an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene

copolymer component, a polypropylene component, a filler component (*e.g.*, limestone and/or barium sulfate), distilled petroleum products, a dispersion agent, pigments, and regrind/recycle materials may (Block **500**). Exemplary material compositions and quantities for the top layer **12** that can be utilized in accordance with embodiments of the present invention are set forth in **Table 1** above.

A backing layer is bonded to the top layer of recyclable polymeric material in face-to-face contacting relationship therewith (Block **510**). The backing layer may be formed from various materials including, but not limited to, polypropylene foam sheet material, and open cell materials. The bonded top and backing layers are then formed into a desired shape (Block **520**) using any of various known techniques, such as compression molding or vacuum forming.

Referring now to **Fig. 4**, a schematic diagram is provided that illustrates methods of producing a vehicle interior trim panel according to other embodiments of the present invention. Initially, a top layer of recyclable polymeric material having a thickness of between about 1.6 mm and about 2.0 mm and having the following components is provided: an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a filler component (*e.g.*, limestone and/or barium sulfate), distilled petroleum products, a dispersion agent, pigments, and regrind/recycle materials may (Block **600**). Exemplary material compositions and quantities for the top layer **12** that can be utilized in accordance with embodiments of the present invention are set forth in **Table 1** above.

A middle layer of material is bonded to the top layer of recyclable polymeric material in face-to-face contacting relationship therewith (Block **610**). The middle layer may be formed from various materials including, but not limited to, polypropylene foam sheet material, and open cell materials. A reinforced polypropylene substrate is then attached to the backing layer in face-to-face contacting relationship therewith (Block **620**). The combined top layer, middle layer, and substrate are then formed into a desired shape (Block **630**) using any of various known techniques, such as compression molding or vacuum forming.

Referring now to **Fig. 5**, a schematic diagram is provided that illustrates methods of producing a vehicle interior trim panel according to embodiments of the present invention. Initially, a top layer is formed from first and second layers of recyclable polymeric material, which are bonded together in face-to-face relationship (Block **700**). The first layer of recyclable polymeric material includes a first interpolymer component having a composition of about twenty to forty percent (20% - 40%) ethylene and about sixty to eighty percent (60% - 80%) aromatic vinyl monomer, a second interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene copolymer component, a polypropylene component, a polyethylene polymer component, and a silicone component. The first layer has a thickness of between about 0.75 mm and about 1.0 mm. Exemplary material compositions and quantities for the first layer that can be utilized in accordance with embodiments of the present invention are set forth in **Table 2** above.

The second layer of recyclable polymeric material includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%)

ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene copolymer component, a polypropylene component, and a limestone component. The second layer has a thickness of between about 1.0 mm and about 1.25 mm. Accordingly, the top layer has a thickness of between about 1.75 mm and about 2.25 mm. Exemplary material compositions and quantities for the second layer that can be utilized in accordance with embodiments of the present invention are set forth in **Table 3** above.

A backing layer is bonded to the top layer of recyclable polymeric material in face-to-face contacting relationship therewith (Block **710**). The backing layer may be formed from various materials including, but not limited to, polypropylene foam sheet material, and open cell materials. The bonded top and backing layers are then formed into a desired shape (Block **720**) using any of various known techniques, such as compression molding or vacuum forming.

Referring now to **Fig. 6**, a schematic diagram is provided that illustrates methods of producing a vehicle interior trim panel according to other embodiments of the present invention. Initially, a top layer is formed from first and second layers of recyclable polymeric material, which are bonded together in face-to-face relationship (Block **800**). The first layer of recyclable polymeric material includes a first interpolymer component having a composition of about twenty to forty percent (20% - 40%) ethylene and about sixty to eighty percent (60% - 80%) aromatic vinyl monomer, a second interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, a polyethylene polymer component, and a silicone component. The first layer has

a thickness of between about 0.75 mm and about 1.0 mm. Exemplary material compositions and quantities for the first layer that can be utilized in accordance with embodiments of the present invention are set forth in **Table 2** above.

The second layer of recyclable polymeric material includes an interpolymer component having a composition of about sixty to eighty percent (60% - 80%) ethylene and about twenty to forty percent (20% - 40%) aromatic vinyl monomer, a polypropylene/ethylene copolymer component, a polypropylene component, and a limestone component. The second layer has a thickness of between about 1.0 mm and about 1.25 mm. Accordingly, the top layer has a thickness of between about 1.75 mm and about 2.25 mm. Exemplary material compositions and quantities for the second layer that can be utilized in accordance with embodiments of the present invention are set forth in **Table 3** above.

A middle layer of material is bonded to the top layer of recyclable polymeric material in face-to-face contacting relationship therewith (Block **810**). The middle layer may be formed from various materials including, but not limited to, polypropylene foam sheet material, and open cell materials. A reinforced polypropylene substrate is then attached to the backing layer in face-to-face contacting relationship therewith (Block **820**). The combined top layer, middle layer, and substrate are then formed into a desired shape (Block **830**) using any of various known techniques, such as compression molding or vacuum forming.

EXAMPLE 1

The following illustrates a method of producing a vehicle floor covering having a single layer of recyclable material, according to embodiments of the present invention.

Vehicle Flooring - Single Layer

Inspect & Receive Raw Materials	Transfer Materials	**Compounding Extruder**	
DE 200.01		Set Extruder up to match Process Parameters for SLZ	
Inspire 112		FOR EXAMPLE	
H700-12NPH		Extruder Zone Temperatures - 330-440 F	
CaCO3		Die Zones - 330-380 F	
BaSO4		Set Die Gap to meet 1.7-2.0mm sheet thickness criteria	
Shellflex 6702		Set Feed rates to material hoppers to match SLZ formulation	
Zinc Stearate		Set Screw Speed - RPM's and AMP Draw	
		Trim part to 68-78" width - Part Dependent!	
Match Materials to physical specification			
on supplier C&C - verify criteria			
Sheeting Line		**Vac Forming**	
Set Sheeting line up to match Process Parameters for SLZ		Set Fomer to match Process Parameters for SLZ	
FOR EXAMPLE		FOR EXAMPLE	
Line Speed - FPM		Blank Length - 90"	
Roll Stack Gap - 1.7-2.0mm Thickness criteria		Material Oven Dwell - 35 seconds	
Roll stack temperatures - top - bottom 210-240 F		Material Maximum Temperature - 350 F	
		Top Oven - 100%	
		Bottom Oven - 50-80%	
Foam or Fiber Attachment		**Water Jet or Trimming**	
Attach OEM desired component		Trim part to OEM criteria on OEM vehicle drawings	
Apply adhesive attach fiber		Set cycle time to match one step flow of process	
FOR FOAM - Set Up to SLZ Parameters		Attach clips, etc.	
Material Temperatures - 85-100F		Remove excess material and place in recycling	
Material Ratio 0.95-1.1		Verify proper cut and clean part as required	
Shot Size - 4-10 Seconds			
Inspect and Ship			
Verify part matches all OEM criteria			
Place part on trimming inspection buck to verify trimming operation			
Label product accordingly			
Place part in shipping container			
Transfer to shipping			
Ship product			

EXAMPLE 2

The following illustrates a method of producing a vehicle floor covering having two layers of recyclable material, according to embodiments of the present invention.

Vehicle Flooring - Two Layers

Inspect & Receive Raw Materials			**Compounding Coextruder**					
Bottom Layer	Top Layer	Transfer Materials	**Set Extruder up to match Process Parameters for DLZ**					
DE 200.01	DE 200.01		FOR EXAMPLE					
Inspire 112	DS 201.01		Set both Extruder Zone Temperatures - 330-440 F					
H700-12NPH	Inspire 112		Die Zones - 330-380 F					
CaCO3	H700-12NPH		Set Die Gap to meet 1.7-2.0mm sheet thickness criteria					
Shellflex 6702	DMB 1200.1		Set Feed rates to material hoppers to match DLZ formulation					
Zinc Stearate	Dowlex 2045		Set Both Screw Speeds - RPM's and AMP Draws					
Pigment	Pigment		Trim part to 68-78" width - Part Dependent!					
			Verify color is correct - Sample - test w/ MacBeth to OEM					
Match Materials to physical specification			Verify Top Layer thickness - 0.5-.8mm, Bottom Layer - 1.2-1.5mm					
on supplier C&C - verify criteria								
Sheeting Line					**Vac Forming**			
Set Sheeting line up to match Process Parameters for DLZ					**Set Fomer to match Process Parameters for DLZ**			
FOR EXAMPLE					FOR EXAMPLE			
Line Speed - FPM					Blank Length - 90"			
Roll Stack Gap - 1.7-2.0mm Thickness criteria					Material Oven Dwell - 50 seconds			
Roll stack temperatures - top - bottom 210-240 F					Material Maximum Temperature - 350 F			
					Top Oven - 100%			
					Bottom Oven - 50-80%			
Foam or Fiber Attachment					**Water Jet or Trimming**			
Attach OEM desired component					Trim part to OEM criteria on OEM vehicle drawings			
Apply adhesive attach fiber					Set cycle time to match one step flow of process			
FOR FOAM - Set Up to DLZ Parameters					Attach clips, etc.			
Material Temperatures - 85-100F					Remove excess material and place in recycling			
Material Ratio 0.95-1.1					Verify proper cut and clean part as required			
Shot Size - 4-10 Seconds								
Inspect and Ship								
Verify part matches all OEM criteria								
Place part on trimming inspection buck to verify trimming operation								
Label product accordingly								
Place part in shipping container								
Transfer to shipping								
Ship product								

EXAMPLE 3

The following illustrates a method of producing a vehicle interior trim panel having two layers of recyclable material, according to embodiments of the present invention.

Trim Panel - Two Layers

Inspect & Receive Raw Materials		Transfer Materials	Compounding Coextruder
Bottom Layer	Top Layer	Laminate	Set Extruder up to match Process Parameters for Tuf Trim
(used w/o foam)	DE 200.01	PP or PE Foam	FOR EXAMPLE
DE 200.01	DS 201.01		Set both Extruder Zone Temperatures - 330-440 F
Inspire 112	Inspire 112	Substrate	Die Zones - 330-380 F
H700-12NPH	H700-12NPH	Poypropylene	Set Die Gap to meet 1.7-2.0mm sheet thickness criteria
CaCO3	DMB 1200.1		Set Feed rates to material hoppers to match DLZ formulation
Shellflex 6702	Dowlex 2045		Set Both Screw Speeds - RPM's and AMP Draws
Zinc Stearate	Pigment		Trim part to 28-42" width - Part Dependent!
			Verify color is correct - Sample - test w/ MacBeth to OEM
Match Materials to physical specification			Verify Top Layer thickness - 0.5-.8mm, Bottom Layer - 1.2-1.5mm (w/o foam)
on supplier C&C - verify criteria			

Extruder	Injection Molding	Compression Molding (used w/ sheet laminate)
Load reinforced polypropylene	Load appropriate tool for OEM part	Use appropriate tool for desired product
Set Die Gap to meet 1.7-2.0mm	Set shot size accordingly	Run sheet from laminating operation to Compression Mold
Set Feed rates to material	Load polyprpylene substrate material	Load desired tool for part to compression equipment
Set Both Screw Speeds - RPM's and AMP Draws		Set up appropriate pressures and temperatures to match part

Sheeting Line w/ Laminating	Vac Forming or Compression Molding
Set Sheeting line up to match Process Parameters for Tuf Trim	
FOR EXAMPLE	FOR EXAMPLE
Line Speed - FPM	Vac Forming (used w/ injection)
Roll Stack Gap - 1.7-2.0mm Thickness criteria	Blank Length - 45-60" - OEM Part dependent
Roll stack temperatures - top - bottom 210-240 F	Material Oven Dwell - 50 seconds
Load Polypropylene Foam Laminate (if no bottom layer)	Material Maximum Temperature - 280 F
	Spray injection substrate with appropriate glue
	Dry glue to specified parameters
	Use appropriate tool for desired product - load correct substrate from injection

Water Jet or Trimming	Assembly	Inspect and Ship
Trim part to OEM criteria on OEM vehicle drawings	Add OEM desired components	Verify part matches all OEM criteria
Set cycle time to match one step flow of process	Use error proofing to verify component build	Label product accordingly
Attach clips, etc.	Attach sound proofing material as needed	Place part in shipping container
Remove excess material and place in recycling		Transfer to shipping
Verify proper cut and clean part as required		Ship product

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof.

Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.